(3) Between 150 percent of minimum speed and 3 times minimum speed, the standard continuous horsepower rating with a temperature rise of 40 C will vary with the speed along a straight line connecting these two horsepower ratings. No further increase in horsepower is recognized above 3 times minimum speed.

(4) Below 150 percent of minimum speed the lower continuous horsepower rating (see preceding item 1) will apply with a temperature rise of 50 C.
*Example:* 20/25 hp, 400 to 1600 rpm. This motor may be rated 20 hp, 40 C at 600 rpm and 25 hp, 40 C from 1200 to 1600 rpm. Between 600 and 1200 rpm the rated horsepower increases directly with speed from 20 to 25 hp.

(5) Motors may also be rated 1 hour with temperature rise of 50 C with the higher horsepower rating (see preceding item 2) throughout the entire speed range.
*Example:* 20/25 hp, 400 to 1600 rpm. This motor may be rated 25 hp, 50 C 400/1600 rpm; 1 hour.

## Mechanical Modifications

*Vertical Mountings* are available for such applications as pumps and agitators. This type of application may require a special umbrella-type hood to pretect against dripping liquids.

*Flanged Mountings* are available for use where motors are built in as part of machines. Motors may also be supplied with flush plate mountings, suitable for close coupled pump and similar applications.

CHAPTER 41

# SOUND CONTROL

Unit of Noise Measurement, Apparatus for Measuring Sound, General Problem, Kinds of Noise, Noise Transmitted Through Ducts, Design Room Noise Level, Noise Generated by Fans, Natural Attenuation of Duct System, Duct Sound Absorbers, Air Supply Noises, Cross Transmission Between Rooms, Controlling Vibration from Machine Mountings

IN ventilating and air conditioning a building or a room, consideration must be given to the effect of the mechanical system on the acoustics of the space conditioned. It is important to consider also that the use of air conditioning often permits keeping the windows closed, thus giving relief from certain external noises, but at the same time increasing the necessity of providing adequate sound control.

It is assumed that in a given space the architect and acoustical engineer have produced a room or rooms which are satisfactory for speech, music, or other uses. The ventilating engineer's sole function is to ventilate and air condition these rooms properly so that they will be physically comfortable without adding any acoustical hazards.

## UNIT OF NOISE MEASUREMENT

According to an international standard, the *decibel* (*db*) is the unit for expressing sound pressure levels. The *sound pressure level*, in decibels, is given by the relation:

$$db = 20 \log_{10}\left(\frac{P}{0.0002}\right) \qquad (1)$$

*where* $P$ = the sound pressure in dynes per square centimeter.

The reference pressure (0.0002 dynes per square centimeter) is a sound pressure which is slightly less than the threshold of audibility, at the frequency of 1000 cycles per second, for the person of average hearing. This reference point is approximately the minimum sound pressure that would be audible in a very quiet room to an observer having acute hearing. The ear is essentially a pressure operated device; hence, the sensation of loudness, or magnitude of sound is governed by the sound pressure existing at the point of reception.

The sound level meter measures sound level pressure, the measurement being expressed as *sound level* on a decibel scale with zero corresponding to the reference pressure of 0.0002 dynes per sq cm at 1000 cycles. In the higher ranges of the decibel scale, approaching 120 db, the sensation is one of feeling, and at higher levels the sensation becomes painful.

Associated with sound pressure level is the *sound intensity level*, expressed in decibels above a standard reference intensity. Sound intensity is the average rate of sound energy transmitted through a unit area normal to the direction of propagation, commonly expressed in watts per square centimeter. The *sound intensity level*, in decibels, is given by the relation: